FERMILAB-CONF-06-138-E

Understanding of Decay Length Resolution and its Application to B_s Mixing

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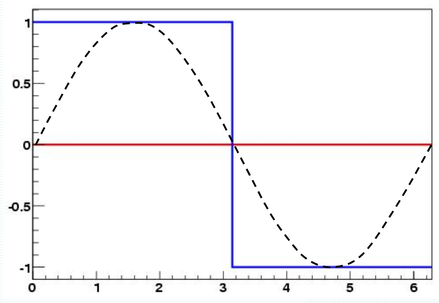
Why does resolution matter?

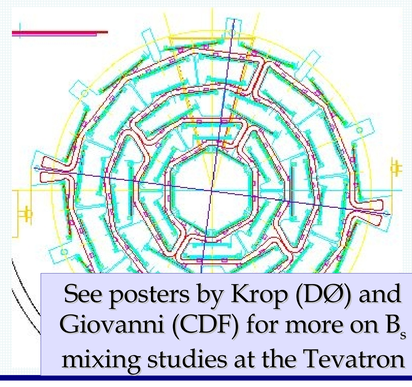
- To see B_s oscillations, need good resolution

Δm_s ~ resolution



- Need resolution ≥ ½ period of oscillation
- If resolution = period
- If resolution = ½ period

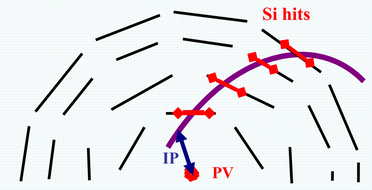
- The resolution depends on the errors of tracks in DØ's silicon system



See posters by Krop (DØ) and Giovanni (CDF) for more on B_s mixing studies at the Tevatron

Tracking Procedure Gives Estimated Errors

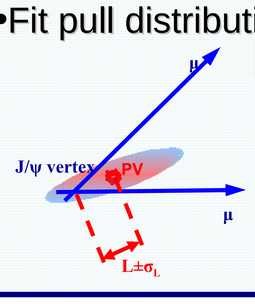
- Ideally, tracking errors are the true errors
- In practice, the errors are underestimated
  - Impact parameter distribution widths → true errors

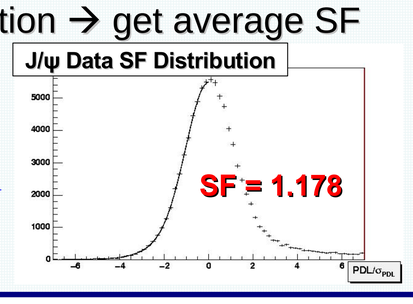


DØ's SMT

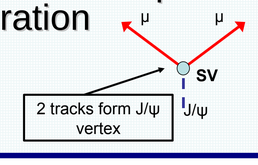
Finding the true tracking errors – Using J/ψ data

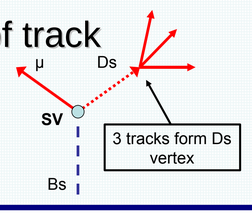
- Find average correction – the Scale Factor (SF)
- Use J/ψ data: clean signal, we can estimate the distribution tails
  - Fit pull distribution → get average SF





- Track configuration of J/ψ and B_s decays is different – can we use J/ψ data for B_s studies?
- Yes, if SF is independent of track configuration



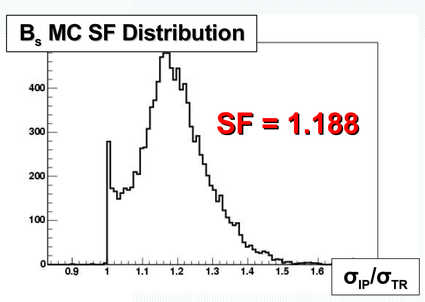


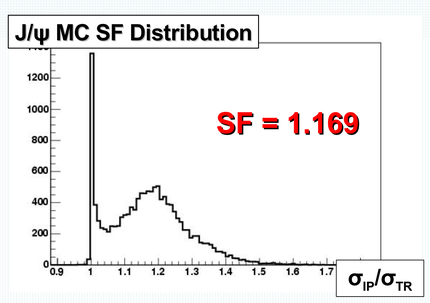
Scale Factor Using the Impact Parameter Tuning Procedure

- Procedure developed at DELPHI, corrects errors on a track-by-track basis
- Separates tracks into categories of silicon hits, includes angles and p_T
- For each track category, tune the errors in two ways:
  - Errors tuned to tracking errors in data: σ_{TR}
  - Errors tuned to widths of impact parameter distributions: σ_{IP}
- Scale Factor = σ_{IP}/σ_{TR}

- Check if SF depends on track configuration, using J/ψ and B_s MC

1.169 ≈1.188 → Scale Factor is independent of track configuration!

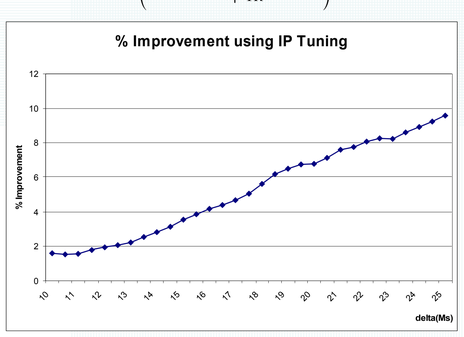




Improving Our Understanding: PartI

- Event-by-event Scale Factor
  - Uses Impact Parameter Tuning Procedure
  - Estimated improvement of 5-10% over average Scale Factor, using Monte-Carlo

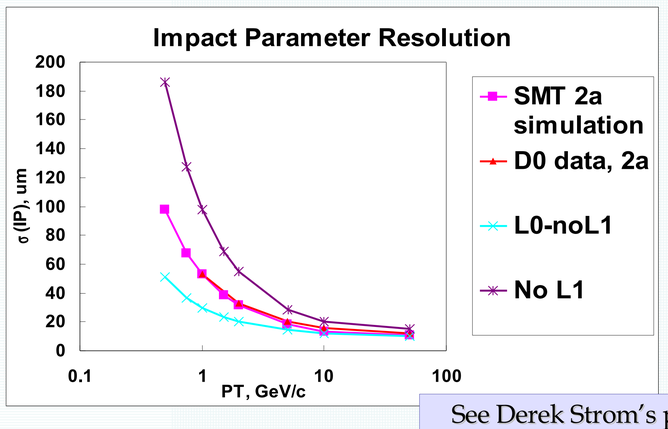
$$\%\,\mathrm{Im} = \left(1 - \frac{\sigma(A)|_{\sigma_{IP}}}{\sigma(A)|_{\sigma_{TR}} \cdot 1.18}\right) \cdot 100\%$$



- Amplitude scan uses σ_{IP} or σ_{TR} as input → get %Im

Improving Our Understanding: PartII

- LayerØ will improve RunIIb resolution
  - Resolution depends on the distance between the primary vertex and the first silicon layer
  - RunIIb resolution improves even if Layer1 fails



See Derek Strom's poster for details on DØ's silicon systems: the SMT and the new LayerØ

Summary of Current and Future Work

- Scale Factor is independent of track configuration, for our case
  - J/ψ data can be used to find B_s Scale Factor
- Event-by-event Scale Factor will give 5-10% improvement over average
  - Estimate studies done using Monte-Carlo
  - Currently producing event-by-event Scale Factor in data to confirm
- LayerØ will improve our resolution during RunIIb
  - LayerØ gives hit information closer to the primary vertex
- Studies using vertex and mass constraints to improve resolution
  - Complimentary to this work, provides additional resolution improvement
- Impact Parameter Tuning Procedure to be available to all at DØ